Silicified Sand-Pipes belonging to *Chaceia* (?) (Pholadidae:Martesiinae) from the Late Miocene of California

BY

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(Plate 21)

INTRODUCTION

A FEW HAND SPECIMENS with several silicified sand and mud-filled pholad burrows and a few silicified pholads were collected by NOMLAND & GESTER in 1916 from Upper Miocene strata in San Luis Obispo County, California. This locality (Univ. Calif. Mus. Paleo. locality A-3415), as described on the label accompanying the collection, is on the Frazer property, about one mile south-east of Huasna school house, near the west central part of Section 29, T.23S., R.15E., San Luis Obispo County, California. These burrows, commonly referred to as "sand-pipes" (see UOZUMI & FUJIE, 1956; MASUDA & TAKEZAWA, 1961; ITOIGAWA, 1963) are mostly elongate, with a long, proximally tapering, sub-circular neck which merges rather smoothly into a bulbous distal portion (Plate 21; Figures 1, 6, 9). A few of the burrows, however, are small and rounded (Plate 21, Figures 3, 8), and lack the typical elongate neck of the former.

The sand-pipes originate in whitish-gray, fine-grained and tuffaceous silty sandstone, and penetrate the underlying hard, dull greenish-brown, siliceous and cherty mudstone of "Monterey type" (see BRAMLETTE, 1946). Because of the high silica content of the penetrated rocks (BRAMLETTE, *op. cit.*), the burrows, as well as their contents have been partially silicified, most of them having a dull, glassy appearance (Plate 21, Figures 1, 2, 4). In a few specimens, faint indications of the original occupant can still be discerned with some difficulty. These (Plate 21, Figures 4, 7, 8) have thin-walled, extremely short and bulbous valves, which probably fit rather loosely along the dorsal and ventral margins. There is also some indication of the presence of wide anterior and posterior gapes (see below, and Plate 21, Figures 7, 8). These characters, especially the short bulbous valves preclude their inclusion with some common pholad genera such as *Pholadidea, Penitella,* and *Zirfaea* which are typically elongate; but they are highly suggestive of the genus *Chaceia* TURNER, 1955. As none of the specimens could be satisfactorily extracted from the matrix for detailed study no specific name is suggested for the pelecypods in this report.

STRATIGRAPHY

The lithology and stratigraphic relationships of Late Miocene strata in the San Luis Obispo area are aptly and succinctly described by BRAMLETTE (1946, p. 6). In this region, the siliceous Monterey Formation is overlain by tuffaceous, whitish-gray sandstone beds of the Pismo Formation. The latter is generally regarded as a lateral equivalent of the Late Miocene Santa Margarita Formation (BRAMLETTE, 1946, p. 6; FAIRBANKS, 1904, p. 4).

The pholad burrows originate in the tuffaceous Pismo Formation, and project half to more than three inches down into the underlying hardened, greenish-brown, siliceous chert of the Monterey Formation (Plate 21, Figures 5, 8, 9). The disconformable relationship between these two lithologic entities is apparent from the largest figured specimen (Plate 21, Figure 9). Here, the proximal ends of all the sand-pipes are aligned along the irregular erosional contact of the fine-grained sandy Pismo Formation with the underlying Monterey chert. There is, however, no doubt that the initial ends of the sand-pipes originated in the overlying Pismo Formation. Furthermore, the burrows, though mostly enclosed in the hard cherty rocks, are completely filled with fine-grained, light gray, tuffaceous sediments similar in texture and composition to those of the Pismo sandstone. Thus, the organisms inhabiting them must have lived during the deposition of the latter.

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SAND-PIPES

The sand-pipes examined fall into two gross morphologic types (Plate 21). All have a sub-circular cross-sectional outline. The majority of them are elongate, with a long neck through which the siphon was extended, and a short bulbous distal end in which the borer lived. A few burrows are small and spherical with no elongate neck (Plate 21, Figures 3, 8). Intermediate forms with short, slender necks (Plate 21, Figures 5, 9) complete the gradational morphological spectrum. Inasmuch as the observed variations in length of burrow coincide with a similar gradation in size, the small, spherical forms are here regarded as young individuals; the gradually increasing length of neck representing a continuous increase in siphonal length with age. The smallest sand-pipe observed is about 4 mm long, and the longest about 66 mm.

The mollusks fit snugly into their burrows and apparently have very little freedom of movement laterally. Such tight-fitting burrows are characteristic of species that burrow into hard substrates (Turner, 1955). The disconformity between the Pismo Formation, in which the sand-pipes originate, and the underlying Monterey Formation into which they burrowed indicates that the Monterey sediments had been consolidated, and eroded before the area was invaded by the borers. In this, and in other similar studies of boring bivalves (Uozumi & Fujie, 1956; Adegoke, 1966), it is commonly found that a very large number of borers live and burrow side by side in small pockets (see Plate 21, Figures 5, 9).

Faint impressions of occupants are visible in a few of the silicified burrows (Plate 21, Figures 2 - 5, 7 - 8). In general, the short distal portion of the burrow occupied by the borer is hollow and thin-walled when well preserved. In one specimen (Plate 21, Figures 4, 7), the thin valves and the elongate-oval posterior gape are preserved. On one side of the same specimen (Plate 21, Figure 4), a faint, straight, shallow groove between the closed valves indicates that the valves probably fitted only loosely together in the living animal. A few specimens (Plate 21, Figures 2, 7) show faint indications of what might have been radial lamellar ribs. In all cases where remains of the original occupants are visible, the valves are characteristically short, with an oval outline, and a relatively small length/height ratio. Additionally, they appear to have been buried *in situ,* that is with the rounded anterior end pointing vertically downward and the siphonal end pointing upward. The numerous holes visible in the anterior region of the burrows (Plate 21 Figures 1 - 5) probably indicate presence of a weakened anterior region which is here interpreted as indicative of the presence of a wide anterior (pedal) gape, which is, at best, only partially closed by a callum.

AFFINITIES

Because no well-preserved specimen could be extracted for study, the affinities of these fossils are not definitely known. However, the remarkably short body, spherical or ovoid outline, thin-walled valves, probable presence of pedal and siphonal gapes, and the faint lamellar ribs not unlike those of *Chaceia* (see Turner, 1955), suggest probable affinities with that genus.

Another evidence suggestive of probable relationship between these fossils and *Chaceia* is the similarity in the habitat preferences of both. According to Turner (1954), *Chaceia ovoidea* (Gould, 1851), the only known species of the genus, lives in soft shale rock in association with *Penitella penita* (Conrad, 1837), *P. gabbii* (Tryon, 1863), and *Parapholas californica* (Conrad, 1837). The boring habits of most of these associated genera have been extensively studied by many earlier workers and were recently reviewed by Yonge (1951, 1951a) and Turner (1954). All of them, especially *Penitella,* are capable of burrowing

Explanation of Plate 21

Figures 1 to 9: Partially silicified sand-pipes created by *Chaceia* (?) sp. indet., from Univ. Calif. Mus. Paleo. locality A-3415, San Luis Obispo County, California.

Figure 1: Hypotype, UCMP no. 32523, x 1½

Figure 2: Hypotype, UCMP no. 32522, x 1½

Figures 3 and 8: Hypotype, UCMP no. 31410, x 1.9. Specimen showing two small, spherical, thin-walled and hollow burrows probably made by immature individuals.

Figures 4 and 7: Hypotype, UCMP no. 34092. Figure 4, specimen showing hollow distal end and faint, straight groove indicating contact of valves; x 1½. Figure 7, top view of same specimen showing posterior margin of valves and partially exposed siphonal gape; x 1.9

Figure 5: Hypotype, UCMP no. 31409, x 1⅓; hand specimen showing several burrows existing side by side.

Figure 6: Hypotype, UCMP no. 15547; x 1

Figure 9: Hypotype, UCMP no. 12197: x 1; hand specimen showing numerous small and large-sized sand-pipes, and the disconformable relationship between the whitish-gray, fine-grained, tuffaceous sandstone of the Pismo Formation (in which sand-pipes originate) and the underlying hard, greenish-brown, siliceous and cherty mudstone of the Monterey Formation in which the sand-pipes are enclosed.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

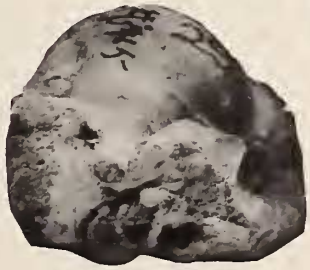

Figure 8

Figure 9